

Siriphat Ruengphayak 2014: Genomic Analysis and Molecular Breeding for High Grain Iron Density and Iron Bioavailability in Rice. Doctor of Philosophy (Genetic Engineering), Major Field: Genetic Engineering, Interdisciplinary Graduate Program. Thesis Advisor: Associate Professor Apichart Vanavichit, Ph.D. 87 pages.

Rice contains the lowest grain Fe content among cereals. One biological limiting factor is the tolerance of rice to Fe toxicity. Two sources of genetic variation, natural and mutants, were utilized in this study. No significant improvement in grain Fe content by phenotypic selection using natural genetic variants as donor. Mutagenized population was developed by fast neutron irradiation and was fixed in four self-pollination. Reverse and forward genetics screenings were designed for identification of high grain Fe density and tolerance to Fe toxicity in M_2 to M_4 populations.

Two types of mutants related to Fe content and Fe toxicity were successfully isolated by forward screening of 12,000 mutagenized lines. Among PPB screened lines so far, 76 mutants contained higher grain Fe density, while only 2 mutants were very low. The Fe grain density was varied from 29 ppm (Mu4643) to 7 ppm (Mu8097). On the other hand, screening for Fe toxicity tolerance at 300 ppm Fe toxic level identified 95 tolerance and 57 susceptible lines compared to the wild type. Moreover, coding sequence amplicons were genotyped on six iron homeostatic genes by using denaturing high performance liquid chromatography (dHPLC). Five mutants were identified in *OsFRO1* (LOC_Os04g36720). One such mutant called 'MuFRO' accumulated 21-30 % more grain Fe content than its wild type on both normal and toxic levels of Fe. To search for mutated genes at the whole genome level, Single Feature Polymorphism (SFP) followed by sequencing revealed four candidate genes for cation transporters, *OsPDR3*, Zinc finger, *OsI-3-GPL* and *OsLLS1*, were distinctively different between the low and high grain Fe content mutants wild type.

Student's signature

Thesis Advisor's signature